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Lassen et al.

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(54) **CONNECTORS FOR LINEAR LIGHTING**

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F21V 15/01	(2006.01)
F21S 4/20	(2016.01)
H01R 25/14	(2006.01)
H01R 4/36	(2006.01)
H01R 4/46	(2006.01)
H01R 9/24	(2006.01)

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CPC ***F21K 9/20*** (2016.08); ***F21V 15/013*** (2013.01); ***F21V 23/003*** (2013.01); *F21S 4/20* (2016.01); *H01R 4/363* (2013.01); *H01R 4/46* (2013.01); *H01R 9/24* (2013.01); *H01R 25/145* (2013.01)

(58) **Field of Classification Search**
CPC . H01R 4/363; H01R 4/46; H01R 9/24; H01R 25/145
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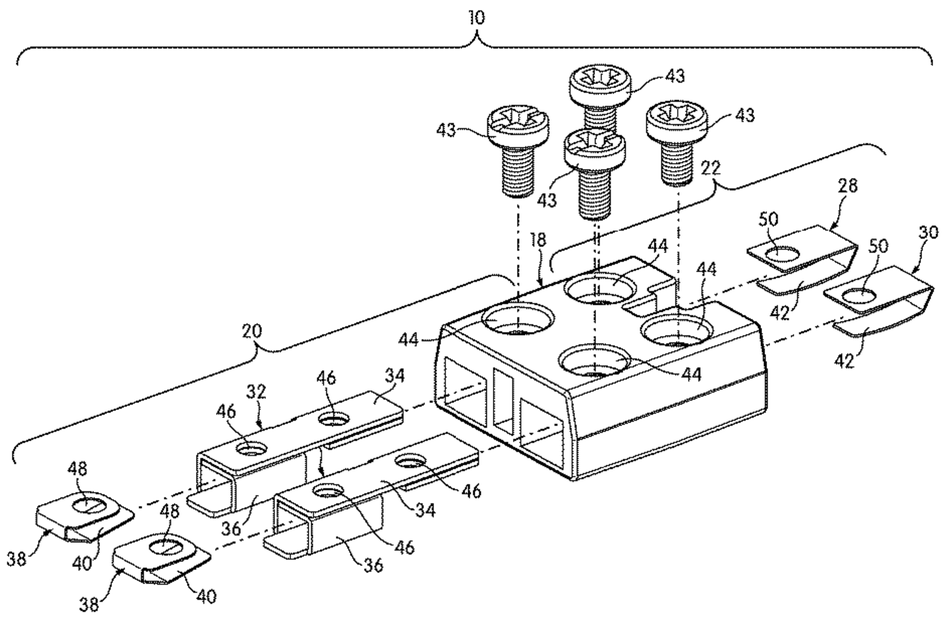
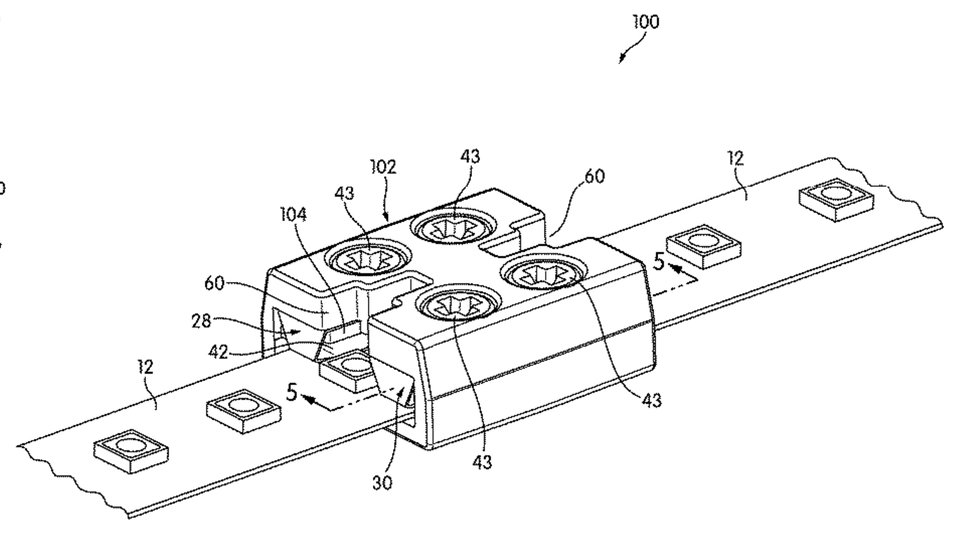
(57) **ABSTRACT**

Connectors for linear lighting are disclosed. These connectors include one side with a slot adapted to accept a strip of linear lighting. The other side may have either another slot for a second strip of linear lighting, if two strips of linear lighting are to be electrically connected end-to-end, or a set of terminal blocks for connecting the strip of linear lighting to wires, such as a set of power leads. The slot has a set of contacts, spaced from one another, that make physical contact with solder pads or other such electrical connecting structures on the linear lighting. The terminal blocks have conductive cages to make contact with the wires. Both the set of contacts in the slot and pressor members in the cages are driven into engagement by sets of adjustable positioning members that bear on them.

14 Claims, 5 Drawing Sheets





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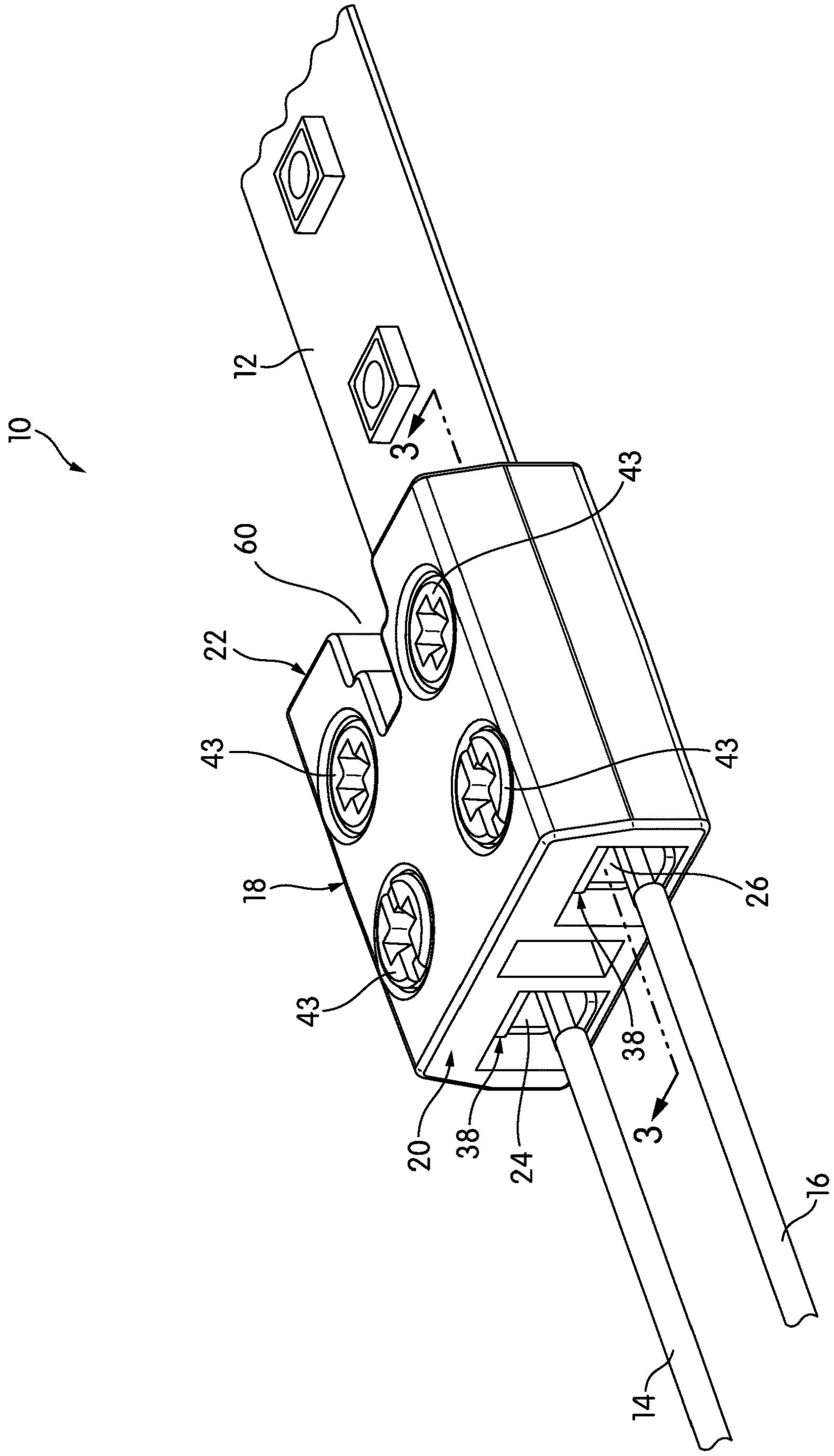

FIG. 1

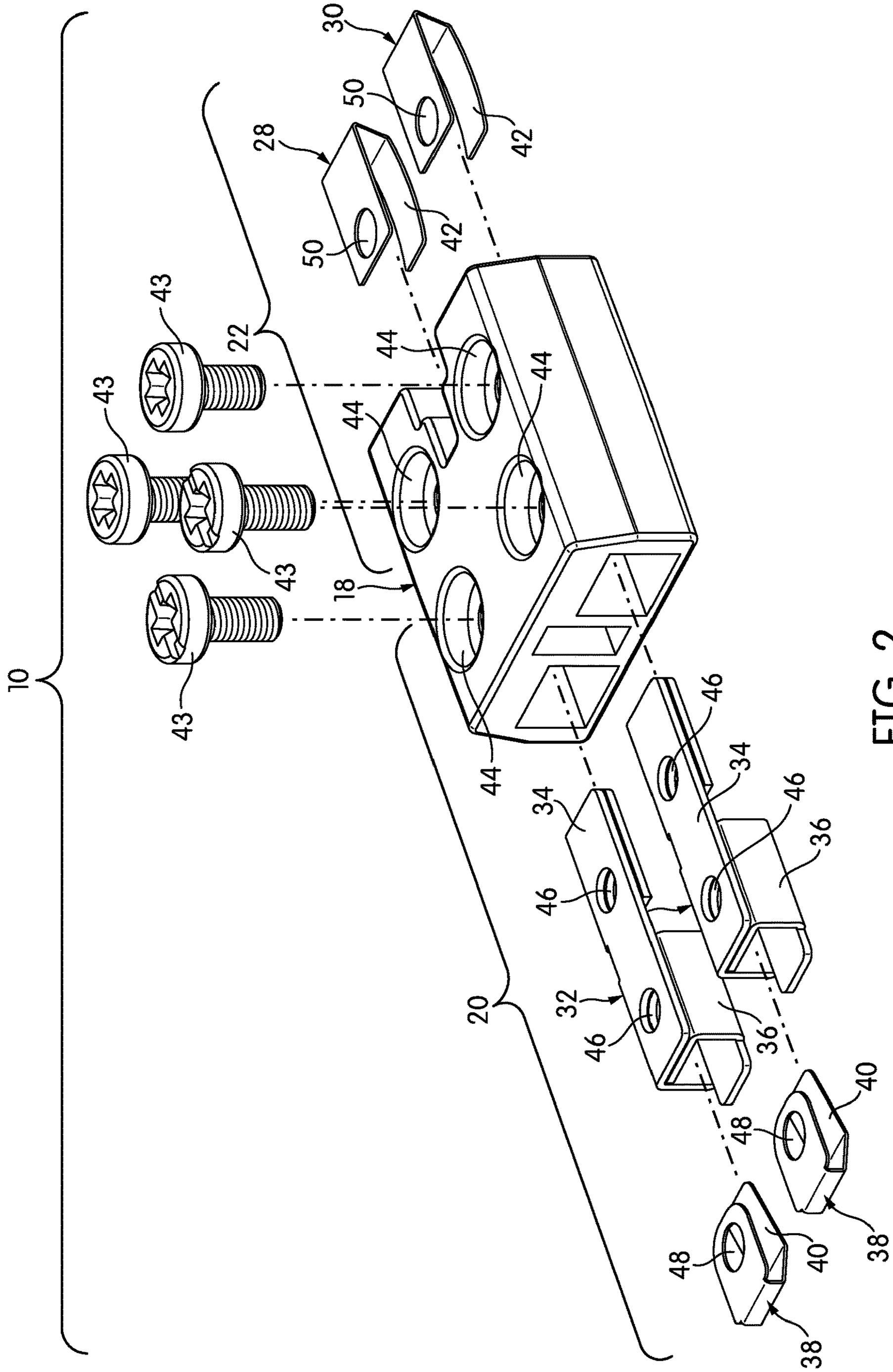

FIG. 2

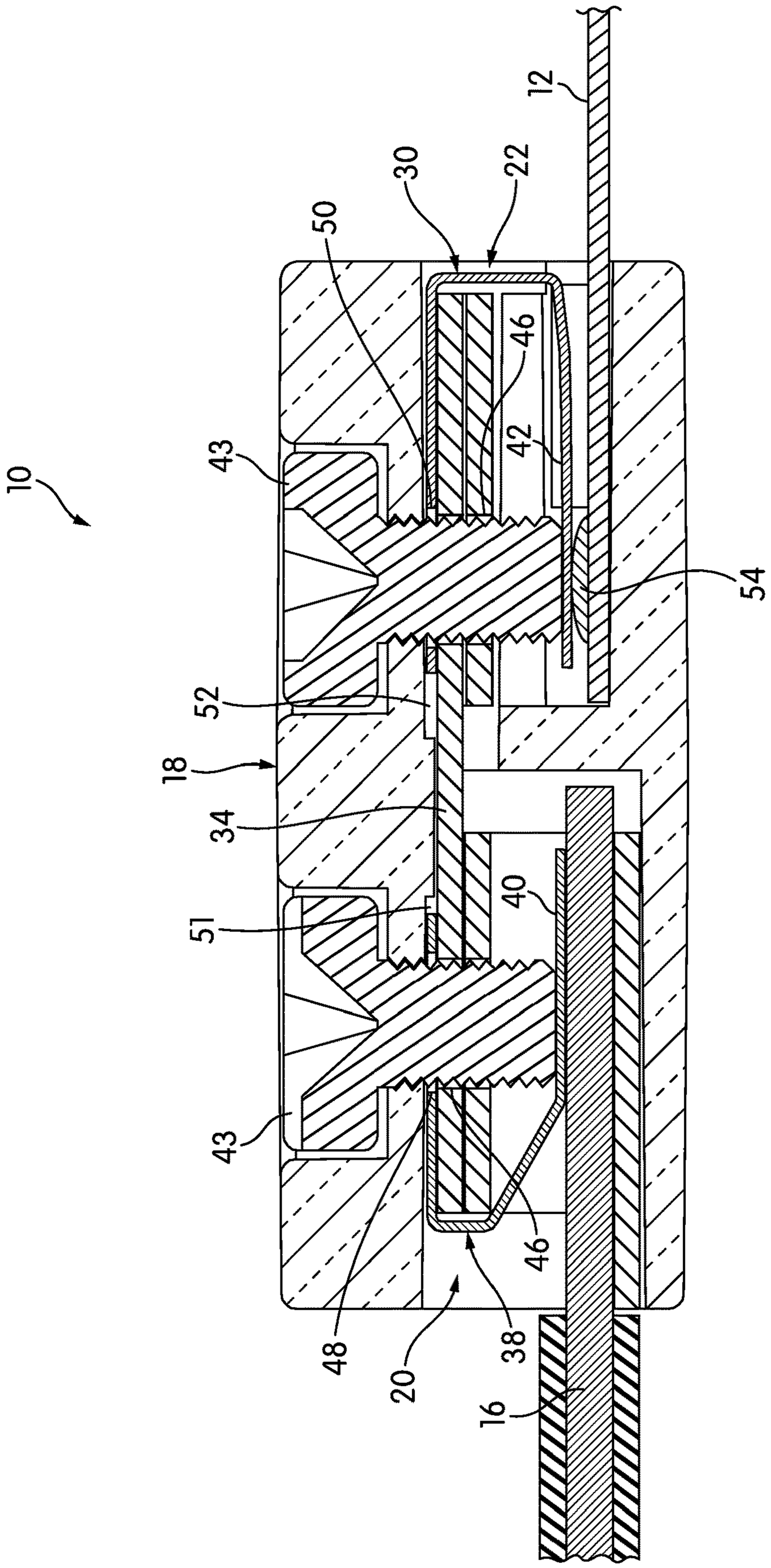

FIG. 3

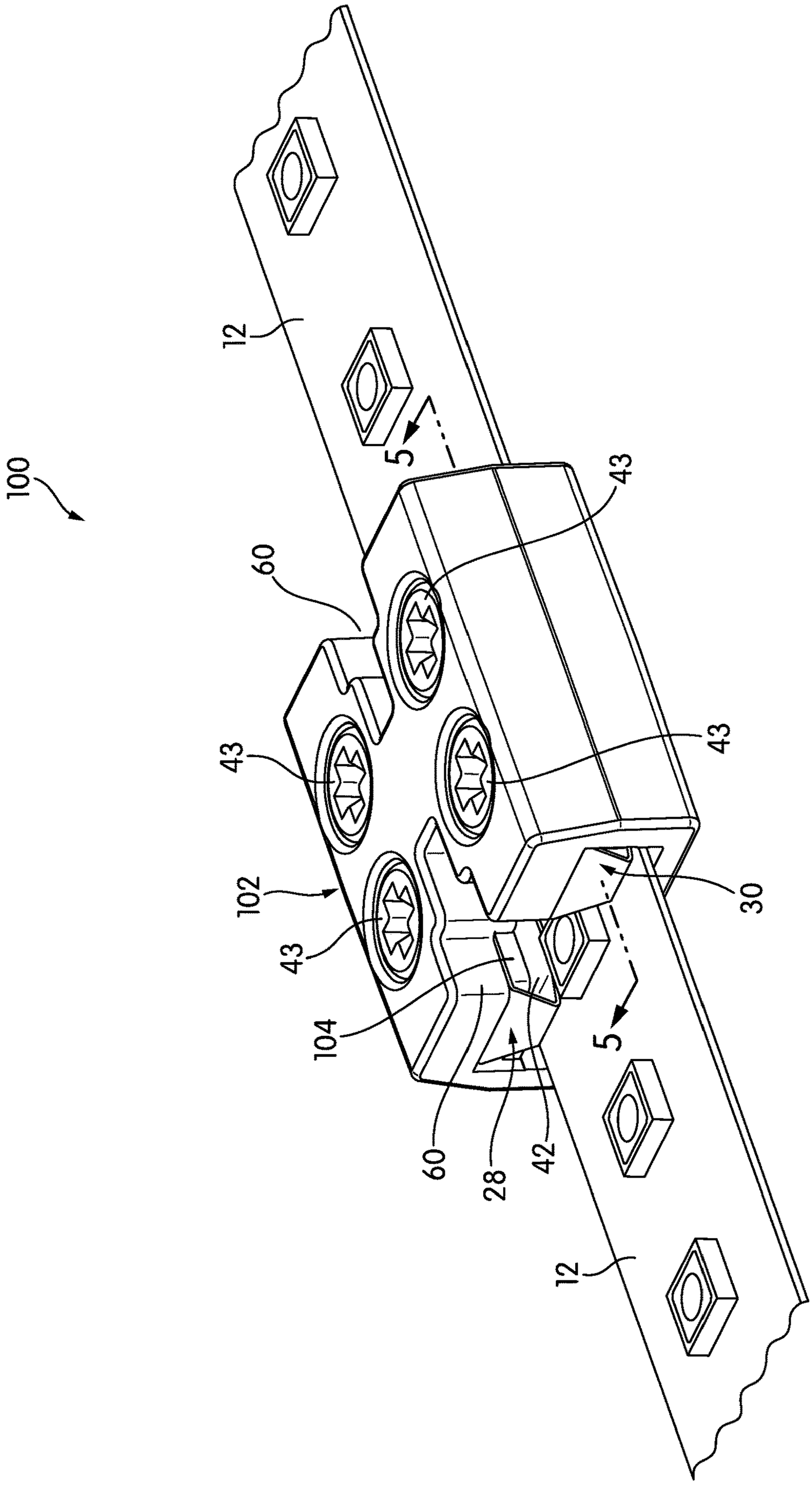

FIG. 4

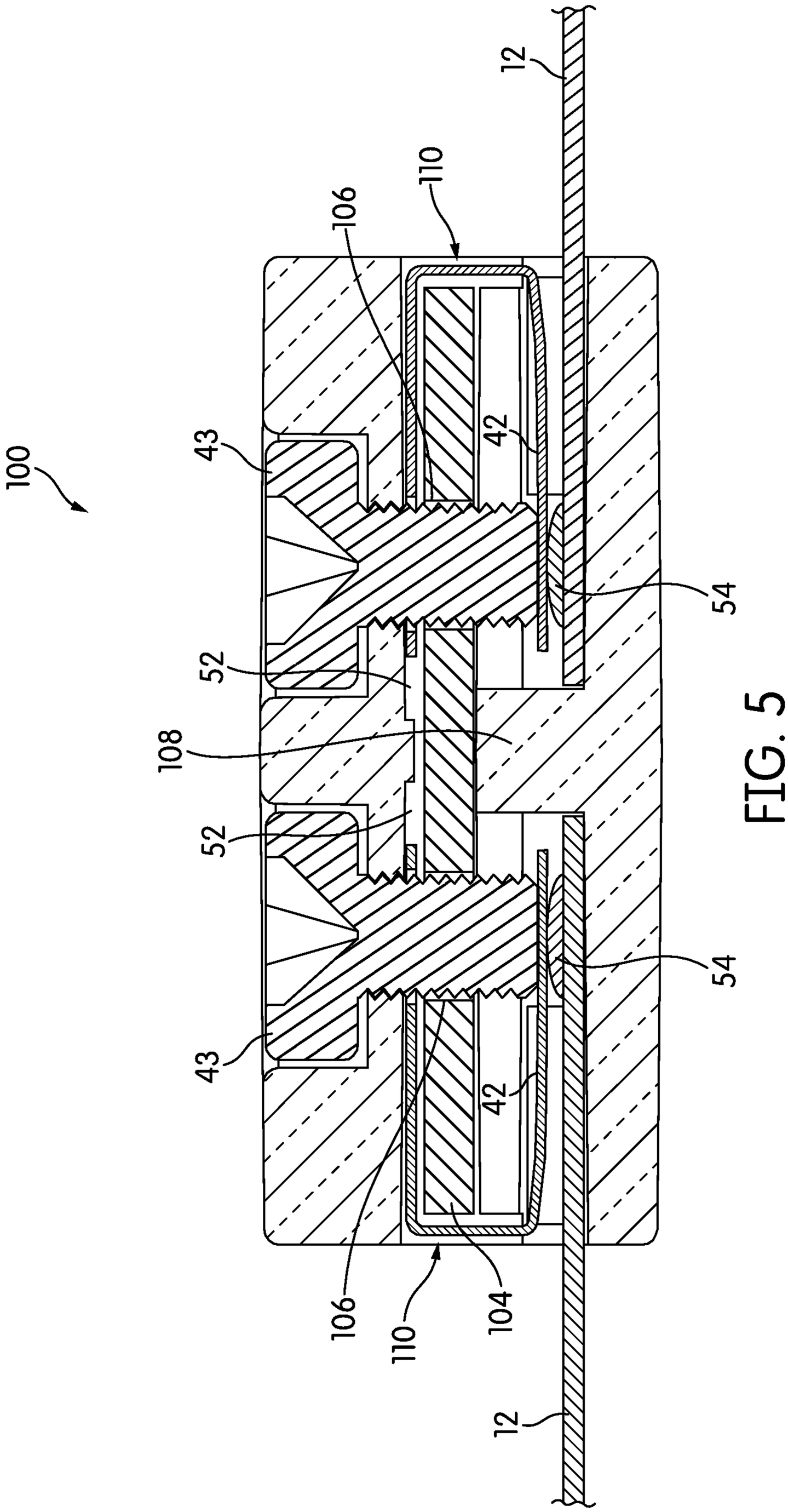

FIG. 5

CONNECTORS FOR LINEAR LIGHTING

TECHNICAL FIELD

The invention relates to connectors for linear lighting.

BACKGROUND

Linear lighting is a particular class of solid-state lighting, the general term for lighting that uses light-emitting diodes (LEDs) as a light source. Typically, linear lighting is comprised of a thin, elongate printed circuit board (PCB) on which are disposed a number of LED light engines, typically spaced at a regular pitch along the PCB. The PCB may be either rigid or flexible, and includes the conductors and other circuit elements necessary to power and control the LED light engines. By connecting shorter strips of linear lighting during the manufacturing process, a finished strip of linear lighting may have essentially any length. Spools of flexible linear lighting 100 feet (30 meters) long are common, and 400-foot (122 meter) spools of flexible linear lighting are commercially available.

The circuits on the PCB of a strip of linear lighting are usually physically and electrically arranged in repeating blocks, so that the PCB can be cut at defined cut points between adjacent repeating blocks. In some cases, linear lighting is cut to a desired length and connected to power during finishing steps in the factory. In other cases, linear lighting may be cut to length in the field by an electrician or other individual who is installing it in a particular location.

Each repeating block of the PCB of a strip of linear lighting usually includes electrical contacts for connecting to power. Connections between the PCB and power are typically made by soldering wires to the PCB. However, soldering is a process that requires skill and practice; poorly done, soldering may damage the PCB or render the PCB more susceptible to damage as the linear lighting ages.

There are connectors on the market that allow for solderless connection between a strip of linear lighting and power leads, and also between two strips of linear lighting. U.S. Pat. No. 9,239,136, the contents of which are incorporated by reference in their entirety, discloses one such set of connectors. With connectors of this type, it can be difficult to maintain a positive connection to the PCB.

SUMMARY OF THE INVENTION

Aspects of the invention relate to connectors for linear lighting. These connectors include one side with a slot adapted to accept a strip of linear lighting. The other side may have either another slot for a second strip of linear lighting, if two strips of linear lighting are to be electrically connected end-to-end, or a set of terminal blocks for connecting the strip of linear lighting to wires, such as a set of power leads. The slot has a set of contacts, spaced from one another, that make physical contact with solder pads or other such electrical connecting structures on the linear lighting. The slot may also have an inwardly-extending notch in its upper surface so that light from an LED light engine that is in or near the slot will be released. The terminal blocks have conductive cages to make contact with the wires. The cages have pressor members in them. Both the set of contacts in the slot and the pressor members in the cages are driven down into positive engagement with the respective structures they contact by sets of adjustable positioning members, such as screws, that bear on them.

Other aspects, features, and advantages of the invention will be set forth in the description that follows.

BRIEF DESCRIPTION OF THE DRAWING FIGURES

FIG. **1** is a perspective view of a connector for linear lighting according to one embodiment of the invention;

FIG. **2** is an exploded perspective view of the connector of FIG. **1**;

FIG. **3** is a cross-sectional view of the connector, taken through Line **3**-**3** of FIG. **1**;

FIG. **4** is a perspective view of a connector for linear lighting according to another embodiment of the invention; and

FIG. **5** is a cross-sectional view of the connector of FIG. **4**, taken through Line **5**-**5** of FIG. **4**.

DETAILED DESCRIPTION

FIG. **1** is a perspective view of a connector, generally indicated at **10**, according to one embodiment of the invention. The connector **10** of FIG. **1** connects between a strip of linear lighting **12** and a set of power leads **14**, **16**. Specifically, the connector **10** has a body **18**. On one side, the body **18** provides a terminal block **20** for the set of power leads **14**, **16**; on the other side, the body **18** provides a slot **22** for the strip of linear lighting **12**.

This description will generally assume that the linear lighting **12** is a two-wire, low-voltage system. Therefore, the terminal block **20** provides two terminals **24**, **26**, one for each of the two power leads **14**, **16**. However, the terminal block **20** need not convey only power; rather, it may also be used to convey control signals or any other type of signal required by the linear lighting **12**. In other embodiments, for example, if the linear lighting is RGB linear lighting, dim-to-warm, or has some other features that require additional signals for power or control, the terminal block **20** could provide additional terminals for wires to convey those signals. Alternatively, the terminal block **20** could link to another terminal block **20** or to another strip of linear lighting **12** with any length of wire in between.

With respect to voltage, while the meaning of the term "low voltage" varies according to the authority one consults, for purposes of this description, that term should be construed to refer to voltages under about 50V. While the connector **10**, and other connectors according to embodiments of the invention, may be used with high-voltage linear lighting, electrical and safety regulations in various jurisdictions may impose additional requirements on the linear lighting and on the connector.

The set of power leads **14**, **16** are typically braided wires, although they may be solid conductors in some embodiments. In most embodiments, they will be between 14-22 American Wire Gauge (AWG), although thinner and thicker wires may be used. Consequently, the terminals **24**, **26** may be sized and otherwise adapted for either that entire range of wire gauges, or a subset of it. For example, a particular terminal block **20** may be adapted to accept wires between 18-22 AWG.

FIG. **2** is an exploded perspective view of the connector **10** of FIG. **1**. As can be seen in FIGS. **1** and **2**, the body **18** of the connector **10** houses a number of components that make electrical contact between the terminals **24**, **26** of the terminal block **20** and contacts **28**, **30** within the slot **22** that connect to the linear lighting **12**. The body **18** itself is usually made of a nonconductive material, such as a plastic,

although it may be made of a metal or another such conductive material if its interior is sufficiently electrically insulated so as not to cause an electrical short. In the illustrated embodiment, the body **18** is made of a transparent plastic, which may provide for better visualization of whether or not the leads **14**, **16** and the strip of linear lighting **12** are properly positioned.

As shown in FIG. **2** and in FIG. **3**, a longitudinal cross-section of the connector **10**, each terminal **24**, **26** has a terminal member **32**. The terminal member **32** is made of a conductive material, such as a metal, and may be folded from sheet metal. At the top of each terminal member **32** is a generally flat connector piece **34**. The connector piece **34** extends substantially the entirety of the length of the body **18** of the connector **10** and is the primary member responsible for connecting the terminals **24**, **28** with the contacts **28**, **30** on the other side of the connector **10**.

On the terminal block **20** side, the terminal member **32** is folded down into a four-sided cage **36**. A thin, resilient, generally C-shaped, conductive pressor member **38**, also made of a metal, fits within the cage **36** and extends downwardly, providing a tongue **40** that presses down resiliently on the power lead **12**, **14**. On the other side, the contacts **28**, **30** are shaped similarly to the pressor members **38**: they are thin, generally C-shaped and have lower tongues **42** that can press down resiliently against the contacts of the inserted linear lighting **12**. The contacts **28**, **30** are also made of metal.

As shown in FIGS. **2** and **3**, four screws **43** insert into corresponding threaded holes **44** in the body **18** of the connector **10**, extending downwardly through corresponding through-holes **46** in the connector piece **34**, as well as through-holes **48**, **50** in the contacts **28**, **30** and the pressor members **38**. As can best be seen in FIG. **3**, when the connector **10** is assembled, the screws **43** extend into the connector body **18**, through the connector piece **34** and bear on the upper surfaces of the tongues **40**, **42**, forcing the tongues **40**, **42** downward and into contact with the conductors **14**, **16** and the linear lighting **12**. The screws **43** themselves may all be the same length, or they may be different lengths. As can be seen in the view of FIG. **3**, the screw **43** that secures the wire **16** is slightly shorter than the other screw **43**, so that the screws **43** all rest at the same level and bear against the connector **10**. However, that need not be the case in all embodiments.

The arrangement of the connector **10** means that the screws **43** themselves need not be conductive, although they may be in some embodiments. This is because the screws **43** never make electrical contact with the leads **14**, **16** or the strip of linear lighting **12**. Rather, they bias the contacts **28**, **30** and the pressor members **38** into contact with those elements. Plastic screws **43**, or screws **43** made of another nonconductive material, may be used in some embodiments in order to better protect against electrical shorts. Moreover, while the term "screw" is used in this description, any adjustable positioning member that can exert force on the tongues **40**, **42** to bias them into contact may be used. In some embodiments, members that can be tightened manually may be used.

As shown in FIG. **3**, the tops of the contacts **28**, **30** and the pressor members **38** rest in slight recesses **51**, **52** in the upper portion of the body **18**. The connector pieces **34** of the terminal members **32** insert under the contacts **28**, **30** and the pressor members **38**, essentially wedging the tops of those components in place.

On the side of the slot **22**, the tongues **42** would typically make contact with solder pads **54** formed on the linear lighting **12**. Generally speaking, a solder pad **54** is a defined area for solder connections. Most solder pads **54** are locations where conductive traces or material are broadened or exposed to permit electrical connections to be made. Typically, as is the case in FIG. **3**, the solder pad **54** is covered with solder, providing a raised surface for contact.

This arrangement has several advantages. First, the leads **14**, **16** are caged within the cages **36** of the terminals **24**, **26**. This provides for all-around electrical contact between the leads **14** and the terminal members **32**. Additionally, rather than engaging directly with a screw **43** to establish physical and electrical contact, the screws **43** push on wide, flat tongues **40**, **42** that make physical and electrical contact with the elements **12**, **14**, **16**. This may provide for more contact surface area and thus better and more consistent contact.

The body **18** of the connector **10** may be manufactured in any convenient way. In the embodiment of FIGS. **1-3**, the connector **10** is made in top and bottom halves, each of which is injection molded. The body **18** is specifically adapted for use with linear lighting **12**. Specifically, as shown in FIGS. **1** and **2**, the body **18** includes a wide notch **60** aligned with the longitudinal centerline of the body **18**. The notch **60** is stepped in width, broader close to the edge of the body **18** and stepping down to a narrower width as it extends into the body **18**. When a strip of LED lighting **12** is inserted into a connector **10** such as this, there is the possibility of obscuring the light from the LED light engine that is nearest to the solder pads **54** that are being used for connection. The notch **60** provides space to allow light from the last LED light engine on the strip **12** to escape, preventing both wasted light and dark spots. As will be described in more detail, the walls of the notch **60** may be set so as to allow for maximum beam width for the escaping light.

FIG. **4** is a perspective view of a connector, generally indicated at **100**, according to another embodiment of the invention. More specifically, whereas the connector **10** of FIGS. **1-3** connects between a pair of power leads **14**, **16** and a strip of linear lighting, the connector **100** of FIG. **4** connects between two strips of linear lighting **12**. In many ways, the connector **100** includes the features of the linear lighting **12** side of the connector **10**, symmetrically duplicated.

More specifically, the body **102** includes two notches **60**, one on each side of the connector **100**, so that the last LED in each strip **12** is exposed despite the connector **100**, as described above. As can be seen in FIG. **4**, the contacts **28**, **30** are trapezoidal in shape as viewed from the front, with the narrower side facing down and making contact with the linear lighting **10**. In other words, the tongues **42** are narrower than the tops of the contacts **28**, **30**. This may provide more space for an LED light engine in the slot **60**, and may also avoid making contact with other structures on the linear lighting **12**, which could cause a short.

FIG. **5** is a cross-sectional view of the connector **100** taken through Line **5-5** of FIG. **4**. One primary difference between the connector **10** and the connector **100** is in how the two sides of the body **102** are connected to one another. In the connector **100**, there is no connecting member **32** with a connecting piece **34**. Instead, a flat, rectilinear connecting piece **104** simply extends straight across the body **102** of the connector in the view of FIG. **5**; the connecting piece **104** has holes **106** to allow the screws **43** to pass, and is located just below the upper parts of the contacts **28**, **30**, which extend within recesses **52** in the upper portion of the body **102**. A bar **108** rises up from the interior bottom of the body **102** and extends transversely across the body **102** to support the two connecting pieces **104**, one for each of the contacts

28, 30. The bar 108 also forms the barrier between the slots 110 for the two strips of linear lighting 12.

In this description, the term "about" means that variation around the stated value or range is permitted so long as the variation does not change the desired or described outcome. If it cannot be determined what set of values would change the desired or described outcome, the term "about" should be read to mean±5%.

While the invention has been described with respect to certain embodiments, the description is intended to be exemplary, rather than limiting. Modifications and changes may be made within the scope of the invention, which is defined by the appended claims.

What is claimed is:

1. A connector, comprising:

a body, including

a first side having

a first notch in a top portion of the body, the first notch extending inwardly from an edge thereof,

a first slot extending inwardly from the edge, aligned with and below the first notch, and

two or more conductive first contact members within the first slot; a conductive member for each of the two or more first contact members, the conductive members making electrical contact with respective ones of the two or more first contact members and extending from the first side to a second side of the body;

the second side receiving the conductive members and being adapted to make an electrical connection with the first side through the conductive members; and

an adjustable positioning member for each of the two or more first contacts, the adjustable positioning members extending through the body from a top surface thereof and bearing on the two or more first contact members to force the two or more first contact members downwardly.

2. The connector of claim 1, wherein:

the second side further comprises a terminal block corresponding to each of the two or more first contact members, each of the terminal blocks including

a cage connected to one of the conductive members, the cage having an opening that corresponds with an opening of the terminal block, and

a pressor member within the cage; and

the body further comprises an additional adjustable positioning member for each of the terminal blocks, the additional adjustable positioning members extending through the body from the top surface thereof and bearing on the pressor members to force the pressor members downwardly.

3. The connector of claim 2, wherein each cage is formed on an end of each conductive member.

4. The connector of claim 3, wherein each cage is four-sided and has an opening that coincides with an opening of the terminal block.

5. The connector of claim 2, wherein each cage is adapted to receive a wire such that the pressor member makes electrical contact and drives the wire against the walls of the cage.

6. The connector of claim 1, wherein:

the second side further comprises

a second notch in the top portion of the body, the second notch extending inwardly from an edge thereof, opposite and aligned with the first notch of the first side,

a second slot extending inwardly from the edge of the second side, aligned with and below the second notch, and

two or more second contact members spaced from one another within the second slot, the second contact members being connected to respective opposite ends of the conductive members; and

the body further comprises an additional adjustable positioning member for each of the second contact members, the additional adjustable positioning members extending through the body from the top surface thereof and bearing on the second contact members to force the second contact members downwardly.

7. The connector of claim 6, wherein the first and second slots are adapted to receive strips of linear lighting such that the first and second contact members, respectively, make electrical contact with the strips of linear lighting.

8. The connector of claim 6, wherein the first contact members are trapezoidal in front elevation, wider at their tops than their bottoms.

9. The connector of claim 6, wherein the second contact members are trapezoidal in front elevation, wider at their tops than their bottoms.

10. The connector of claim 1, wherein the body is made of a nonconductive material.

11. The connector of claim 1, wherein the adjustable positioning members comprise screws.

12. The connector of claim 1, wherein the first contact members are trapezoidal in front elevation, wider at their tops than their bottoms.

13. A connector comprising:

a first side with a slot configured to accommodate a strip of linear lighting, the slot having at least two electrical contacts, spaced from one another, that are adapted to be driven down into engagement with the strip of linear lighting by a first set of adjustable positioning members that bear on surfaces of the at least two electrical contacts; and

a second side with at least two terminal blocks in electrical communication with the at least two electrical contacts, each terminal block including a conductive cage and a pressor member within the cage, the pressor member adapted to be driven down into engagement by second adjustable positioning members that bear on the pressor member.

14. The connector of claim 13, wherein the slot comprises a recessed notch, the recessed notch extending inwardly from an edge of an upper portion thereof.

* * * * *